

## MOTION OF THE OCEAN

*This lesson plan was developed by The Monitor National Marine Sanctuary. The activity is available as a component of a field trip offered by The Mariners' Museum.*

### NATIONAL STANDARDS

- Science as Inquiry (5-8, 9-12)
  - Ability to do scientific inquiry
  - Understanding of science inquiry
- Physical Science (5-8, 9-12)
  - Properties and changes of properties in matter
  - Motions and forces
  - Transfer of energy
  - Conservation of energy and increase in disorder
  - Interactions of energy and matter
- Earth & Space Science (9-12)
  - Energy in the earth system
- Science & Technology (5-8, 9-12)
  - Abilities of technological design
  - Understandings about science and technology
- Science in Personal & Social Perspectives (5-8, 9-12)
  - Natural hazards
  - Science and technology in society
  - Science and technology in local, national and global challenges

### FOCUS

Ocean Observing Systems & Oceanography

### GRADE LEVEL

Middle School and High School Earth Science, Physical Science and Oceanography

### FOCUS QUESTION

- How do researchers, sailors, fishermen and others accurately forecast conditions at sea—past and present?
- What factors influence sea conditions?
- How do onshore and offshore weather conditions differ?

## LEARNING OBJECTIVES

- Students will gather data for scientific purposes
- Students will interpret data from ocean observing systems, including NOAA Data Buoys to pinpoint sea states
- Students will compare historical and present days methods for navigation and weather prediction

## MATERIALS

- Internet (if available—not required) or copies of current data buoy information found on <http://www.ndbc.noaa.gov>
- Beaufort Wind Scale <http://www.spc.noaa.gov/faq/tornado/beaufort.html>
- *Monitor* National Marine Sanctuary map available online <http://www.sanctuaries.noaa.gov/pgallery/atlasmaps/monitor.html>
- Student worksheet (included)

## PREPARATION

1. Log on to <http://www.ndbc.noaa.gov> to familiarize yourself with the data on the NOAA Data Buoy website.

## AUDIO/VISUAL MATERIALS

Chalkboard, marker board, flip chart or overhead projector to facilitate data summaries.

## TEACHING TIME

One 45-minute class period

## SEATING ARRANGEMENT

Create as many groups of three to four students as possible based on class size.

## KEY WORDS

NOAA  
Data Buoy

Ocean Observing System  
*Monitor* National Marine Sanctuary  
Beaufort Wind Scale  
Onshore  
Offshore

### **BACKGROUND INFORMATION**

Mariners have relied on accurate forecasts of conditions at sea for thousands of years. Matthew Fontaine Maury and others were pioneers in the field of physical oceanography, mapping wind and current conditions for sailors and explorers to more easily navigate the ocean.

Through a series of ocean data buoys and satellites, the National Oceanic and Atmospheric Administration (NOAA) and others use ocean observing systems to collect real time sea conditions and predict the sea state in offshore areas. In this activity, students will record data from three NOAA Data Buoys located off the coast of the Outer Banks of North Carolina. They will then interpret the data via a series of questions. Students will then compare data from historical and present day data from the site of the *Monitor* National Marine Sanctuary. For more information on the USS *Monitor* and the National Marine Sanctuary Program, please visit <http://www.monitor.noaa.gov>

For background information related to ocean-atmospheric interactions visit the science education pages on the NOAA Data Buoy website <http://www.ndbc.noaa.gov/educate/educate.shtml>.

#### **What causes the difference in air temperature over land and water?**

- **CONDUCTION:** The transfer of heat through a medium. This is how we

cook food on top of a stove. The heat from the stove burner is conducted through a medium (a metal pot) to the food.

- **CONVECTION:** The transfer of heat due to the physical movement of an object. We can observe convection by looking at a pot of boiling water. Have you ever noticed that when a pot of water is boiling, the water seems to follow a vertical circular motion? This is convection.
- **RADIATION:** The transfer of heat by means of waves. This is the most difficult method of heat transfer to understand. Yet, we experience it every day. We feel the effects of radiation whenever we stand near a stove or oven which is being used. We feel the heat radiating from the stove or oven to our skin.
- **ANSWER:** Radiation is causing the winter-time air temperatures over water to be warmer than the winter-time air temperatures over land. The heat of the ocean is being given off (radiated) into the air, thus making the air substantially warmer.

#### **What causes the difference in water temperatures over land and water?**

There are several factors which can influence the sea surface temperature of on-shore buoys more so than off-shore buoys. These include river runoff, higher cooling and heating rates, continental air masses, near-shore ocean currents, and upwelling effects. In this exercise the most likely causes include higher heating and cooling rates, continental air masses and possibly near-shore ocean currents.

### **LEARNING PROCEDURE**

1. Divide class into groups of 3-4 students and provide each group with

- a Beaufort Wind Scale, map of the *Monitor* National Marine Sanctuary and student worksheet.
2. Have the students label the three data buoys on the map of the *Monitor* National Marine Sanctuary
  3. Students should complete the chart on page 1 of the worksheet. If internet is available, have them collect current data. If internet is not available visit <http://www.ndbc.noaa.gov> before class and print out observations from the website for the students to use.
  4. Students can determine Beaufort Force and expected sea conditions by using the Beaufort Wind Scale (available online <http://www.spc.noaa.gov/faq/tornado/beaufort.html>)
  5. Have the students answer questions 3-7 on the worksheet
  6. Students can complete Exercise 2 with the log book records from the *Rhode Island* (included on worksheet) and 2005 data from Buoy 41025 (included as an attachment)
  7. Discuss the collected data and worksheet answers with your students.

### THE BRIDGE CONNECTION

<http://www.vims.edu/bridge> click on “Ocean Observing” in the navigation menu for other related activities.

### CONNECTIONS TO OTHER SUBJECTS

Mathematics, Social Studies, English/Language Arts

### EVALUATION

Evaluate the students by the accuracy of their data collection and recording, their work as a team and their inferences.

### EXTENSIONS

1. Compare data buoys across the National Marine Sanctuaries to determine hurricane paths, location of ocean currents and more! Visit: <http://www.sanctuaries.noaa.gov> for a listing of all the sanctuaries.
2. Visit The *Monitor* Center at The Mariners’ Museum in Newport News, Virginia for more interactive activities and to see *Monitor artifacts* <http://www.monitorcenter.org>

### FOR MORE INFORMATION

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### CREDIT

If reproducing this lesson, cite NOAA’s *Monitor* National Marine Sanctuary Program as the source, and provide the following URL for further information <http://monitor.noaa.gov/>

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